

T H E S I S

-----

SOME OBSERVATIONS ON INFANT FEEDING, WITH RESULTS  
OF CLINICAL EXAMINATION OF HUMAN MILK IN  
TWENTY CASES

by

MALCOLM CAMPBELL, M.B., C.M.

-----

ProQuest Number: 13915796

All rights reserved

INFORMATION TO ALL USERS

The quality of this reproduction is dependent upon the quality of the copy submitted.

In the unlikely event that the author did not send a complete manuscript and there are missing pages, these will be noted. Also, if material had to be removed, a note will indicate the deletion.



ProQuest 13915796

Published by ProQuest LLC (2019). Copyright of the Dissertation is held by the Author.

All rights reserved.

This work is protected against unauthorized copying under Title 17, United States Code  
Microform Edition © ProQuest LLC.

ProQuest LLC.  
789 East Eisenhower Parkway  
P.O. Box 1346  
Ann Arbor, MI 48106 – 1346

SOME OBSERVATIONS on Infant Feeding, with Results  
of Clinical Examination of Human Milk in  
Twenty Cases

-----

That preventive medicine can accomplish more for the ultimate general good of the people than any other branch of medical science is an opinion which will admit of almost universal acceptance.

At no other period of life are preservatory efforts of more importance than at that which embraces the first year of existence. The attention of the medical profession and the public concern have at all times been turned to the enormous mortality of this period of life, but we have not yet been able to cope successfully with this great evil.

The Inter-Departmental Committee on Physical Deterioration,<sup>1</sup> as the result of their investigations, make the following statements in their recent report:-

Firstly - "That infantile mortality in this country has not decreased materially during the last twenty-five years, notwithstanding that the general death-rate has fallen considerably";

Secondly - "That the mortality among illegitimate

"children is enormously greater than among children born in wedlock";

Thirdly - "That about one half the mortality occurs in the first three months of life".

There is, however, a very distinct improvement in the mortality returns regarding children under five years of age. Taking 1873 and thirty years later, viz., 1903, in Scotland, out of a total of 30,004 deaths in the earlier year, 12,485 were of children under five; in the latter year, out of 30,863 (a larger number), 10,937 were under five years.

The general death-rate is also slowly but surely declining, but the improvement in infantile mortality, that is, the mortality under one year, is still lamentably small, though some little change for the better can be pointed to in recent years, as can be seen from the following table constructed from official returns:-

Years	General Death Rate per 1,000 of population			Infantile Mortality Rate per 1,000 born		
	England & Wales	Scotland	Glasgow	England & Wales	Scotland	Glasgow
1870-79	21.6	21.8	29.9	149	122	158
1880-89	19.2	20.2	24.7	142	118	147
1890-99	18.3	18.6	22.3	153	128	148
1900	18.2	18.5	22.0	154	128	153
1901	16.9	17.8	21.2	151	129	149
1902	16.2	17.2	20.0	133	113	129
1903	15.4	16.5	19.0	132	117	146
1904	16.2	16.8	19.3	145	123	146
1905	15.2	15.9	17.9	128	-	131

Further concerning Glasgow, if we glance at the figures showing the rate at several monthly periods, we shall find that the mortality is heaviest in the first three months of life, and if we compare the figures with those of former years, the reduction of 15 per cent. in the total infant mortality resolves itself into a reduction of 30 per cent. in the last six months, 16 per cent. in the second three months, and an almost stationary rate in the first three months of life.

Infant Mortality Rate (Glasgow) at several Monthly Periods, 1870-1902<sup>2</sup>

	0-3 Months	3-6 Months	6-12 Months	Total
1870-72	72	31	67	170
1880-82	65	25	58	148
1890-92	70	25	54	149
1900-02	72	26	47	145
Percentage Reduction 1870-72 and 1900-02	-	-16	-30	-15

The above figures plainly show that it is at the commencement of life that the main precautionary efforts must be concentrated. For the reduction of this type of mortality there is an ample field for educative health reform, and a crusade against the heavy infantile mortality can be productive of nothing but good results.

DECLINE OF BIRTH-RATE IN RELATION TO INFANT MORTALITY

-----

In addition to an increasing infantile mortality, we have to contend with a falling birth-rate. The fall in the birth-rate is one of the most striking phenomena of our day, in its being all but universal, and as proceeding at an accelerated pace within the last ten years, though it has been operative in Great Britain for nearly thirty years.

Table of Birth-Rates

-----

Year	Scotland	England & Wales	Glasgow
1891-1900	30.2	29.9	33.6
1901	29.5	28.5	31.7
1902	29.2	28.5	31.9
1903	29.1	28.4	31.9
1904	28.6	27.9	31.0
1905	28.1	27.2	30.0

When these figures are further compared with those of thirty years ago, the comparison is very striking. For the period of 1871-75 the average birth-rate for England and Wales was no less than 35.5. In 1876 it touched

36.3, but since that period a steady decline has set in. In Scotland from 1857 to 1879 the birth-rate was more than 34 per thousand; from 1880 to 1893 it ranged between 30 and 34; since 1893 it has only three times been more than 30, and twice, this year and last year, been below 29. We have thus now reached the lowest birth-rate yet recorded in Scotland.

The decline in France has proceeded for more than fifty years, and during all that period the birth-rate there has been the lowest among civilised countries, having now fallen to 20.9 per 1,000. Whilst all European countries show the same tendency, in none, excluding France, is it so distinctly marked as in Great Britain, in her self-governing Colonies, and in the United States of America. These facts point unmistakably to what has been designated as "race suicide".

A concurrent feature is that the decrease is less marked, or is almost non-existent, in the case of the working classes. This factor must still further affect the infantile death-rate as, the upper classes not contributing their proper share to the birth-rate, the proportion of lower class births, with their admitted tendency to a greater mortality, must be thereby increased in comparison.

Dr. Newman<sup>3</sup> in his recently published work on "Infant Mortality" says:- "That infant mortality is a social problem concerning maternity. From questions of occupation and environment, we must turn in the last instance to the actual feeding and management of an infant by its mother". The general practitioner has evidence of this fact brought before him almost every day, and there can be little doubt that the principal primary cause of infantile mortality is that of improper and unwholesome feeding.

From 1884 to 1886 Dr. Hope of Liverpool<sup>4</sup> made an investigation into the large proportion of deaths of infants from summer diarrhoea, and he reported that "investigation proves incontestably that the deaths of infants from this cause are closely associated with the method of feeding, putrefying food being the medium by which the specific poison is commonly introduced". The deaths amongst children under three months of age, either wholly or partially fed on artificial foods, are fifteen times as great as they are amongst an equal number of infants fed upon breast milk.

Dr. Howarth<sup>5</sup>, the Medical Officer of Health for Derby, has published the results of an inquiry conducted



from November 1900 to November 1903, into the feeding of 8,343 infants born in that town. He found that the mortality per 1,000 among the children who were breast fed was 69.8; among those who were at first breast fed and subsequently hand fed, 98.7; and among those who were wholly hand fed, 197.5.

Dr. Brindley<sup>6</sup>, Medical Officer of Health for County Borough of Bury, during the year 1905 obtained information as to the method of feeding in 1,256 instances, or, 99.35 per cent. of the 1,271 births registered during the year. The results of the investigation are shown in the following table:-

No. of Births	No. of instances in which information was obtained	Nature of Feeding	No. of Deaths	Mortality Percentage
1,271	1,256	Breast 888	43	4.8
		Bottle 368	81	22.0

It is clear from these investigations, and from many others which might be cited from the annual reports of Medical Officers of Health of large cities, that the best method of rearing infants is to bring them up by breast feeding. Many difficulties, however, may come in the way of its fulfilment - illness of the mother - poverty which

compels her to work out of doors - or an undeveloped state of the nipple - are among the most common excusable obstacles. All these factors have tended to make the use of substitutes for mothers' milk to a large extent a necessary evil.

Dr. Chalmers<sup>7</sup> of Glasgow, in his report for 1905, has an interesting statement bearing on this point. The homes of children using the Corporation milk were visited, and the reasons for attending the Depot were given as follows:-

(a) Affecting Mother:-		(b) Affecting Child:-	
Ill-health	98	Diarrhoea	17
No milk	135	Not thriving	92
At work	43	Other causes	14
Dead	<u>19</u>		<u>      </u>
	<u>295</u>		<u>123</u>

It has not to be overlooked, however, that many children do not thrive even when fed in the natural way, because of the unsuitability of the milk for the digestive power of the child.

The only substantial or justifiable reason for artificial feeding is inadequacy of the maternal milk. It is, therefore, important to make certain by an analytical examination that this is at fault, and before insisting

on the cessation of breast feeding, we should use all possible means to improve the maternal milk. We must, therefore, acquaint ourselves with the normal composition of human milk, and the influences affecting the quantity and quality of the supply.

#### CHARACTERS AND COMPOSITION OF HUMAN MILK

-----

Human milk is a thin, watery, bluish-white, alkaline fluid with a sweetish taste. In composition, human milk resembles the mammary secretion of other animals; the same proximate principles are present in all, but the proportions vary considerably. These constituents are fat, proteids in the form of caseinogen and lactalbumin, carbohydrates in the form of lactose or milk sugar, various salts, and water. There are also contained small quantities of lecithin, cholesterin and neurin.

The specific gravity of human milk ranges from 1,026 to 1,036. An increase of the fat lowers the specific gravity, and a decrease raises it. The proteids and other solids have a reverse effect, while the salts are too insignificant to affect it much. The sugar content

is so remarkably constant that the specific gravity is modified by the fat and proteids alone. Hence, by a knowledge of the specific gravity and the percentage of fat, the quality of the milk can be fairly well estimated for clinical purposes. Monti<sup>8</sup> states that "a breast milk "which has a specific gravity of 1,030 to 1,035, and at "the same time a fat content of 3 to 5 per cent., and in "which only slight changes in these factors occur during "nursing, may be considered a good one". Low fat averages (from 1-2 per cent.) and low specific gravities (1,026 to 1,029) are usually found in the milk of anaemic and poorly nourished women. The foregoing facts are brought out in my own analyses. The average specific gravity in the series of good milks is 1031.5 and in the bad milks, 1030.7, associated also with a low average percentage of fat, namely, 1.6.

The percentage of the different constituents of human milk vary considerably, not only in different women but also at different nursings in the same woman. The following figures show the various averages as stated by leading authorities:-

	Holt <sup>9</sup>	Rotch <sup>10</sup>	Carter & Richmond <sup>11</sup>	Leeds quoted by Ashby & Wright <sup>12</sup>
Fat	4.0	3-4	3.1	4.1
Proteids	1.5	1-2	1.8	1.9
Sugar	7.0	6-7	6.7	6.9
Salts	0.2	0.1-0.2	0.24	0.2
Total Solids	12.7	12-13	11.88	13.2
Water	87.3	87-88	88.12	86.8

In my own series of cases in which the milk agreed with the child, and could therefore be classified as "good" milk, the average composition was found to be:-

Fat	3.4
Proteids	1.7
Sugar	6.87
Salts	0.18
Total Solids	12.23
Water	87.76

Fat, as found in mothers' milk, consists of butyric, caproic, caprylic, myristic, palmitic, stearic and oleic acids. The fat of mothers' milk differs from that of cows' milk in containing fewer volatile acids; it is also in a much finer state of emulsion, and is therefore easier of digestion. The percentages may be stated to vary normally between 3 and 4 per cent. It is increased by increased proteid diet, and diminished by a deficiency of proteid food, also by an excess of fatty foods and by fasting.

The proportion of fat required in infancy is much greater than at any other period of life. The commonest mistake in artificial feeding is to give too little fat. The low percentage present in the numerous proprietary foods is one of the chief reasons for their failure to rank as proper nutriment for an infant. Infants who are fed for a long time upon a food low in fat are very prone to develop rickets. Children fed on these infant-foods are apt to be very fat (due to excess of carbohydrates), but usually anaemic.

Proteid is the form of food in which nitrogen is supplied to the body. It contains nitrogen, carbon, hydrogen, oxygen and sulphur etc. In regard to the proteids in human milk, they are rarely deficient in amount unless the milk is a very dilute one, due either to irregular nursing, or to inadequacy of the mammary gland. Excess is the general defect found in respect of proteid, and this excess may be corrected by diminished frequency of suckling, increased exercise, with regulation of the diet.

Lactose is a peculiar sugar having the chemical formula  $C_{12}H_{22}O_{11} + H_2O$ . The percentage in human milk varies within comparatively small limits, averaging from 6

to 7 per cent.

Salts - The majority of authors state that the average percentage of salts in mothers' milk is 0.20. The principal salts present are:- calcium phosphate, potassium carbonate, sodium and potassium chloride, and potassium sulphate. Vincent<sup>13</sup> states that "we are not yet in a position to make definite use of our knowledge of the character of the mineral matter, or to state whether it has any practical bearing on nutrition, though it would appear probable that, within certain limits, a moderate excess is less to be feared than a marked deficiency".

#### THE ALTERATIONS IN THE COMPOSITION OF HUMAN MILK

-----

Koeppe<sup>14</sup> emphasizes the fact that constant alterations in the composition of mothers' milk occur from hour to hour and day to day. He suggests that the poor results often obtained from the use of carefully selected, pure and sterilized milk are due to its uniform consistence, whereas nature's product shows constant variations.

ALTERATIONS IN QUANTITY. 1 - In cases where the secretion of

milk is either practically absent or so small in amount as to be quite insufficient to meet the needs of the infant, substitute feeding is the only course available. In suitable cases, the quantity may be increased by a nutritious fluid diet such as milk, gruel, cocoa, or animal broths, and also by the improvement of the general health and nutrition by tonics.

2 - When the secretion is excessive, the milk is, as a rule, very poor in both fat and proteids. For the sake of the child it is rarely necessary to diminish the quantity of the milk. If poor in quality, it is better to try to improve it by measures which will lead to an increase of the solid constituents, by the nursing of the child at shorter intervals, and increased liberality of diet.

**ALTERATIONS IN THE QUALITY.** The conditions affecting the quality of mothers' milk are varied, and require careful consideration, as much can be done by their study to convert a bad milk into a good one. Unfortunately, in many cases in practice, it is difficult to obtain the co-operation of the mother in regard to her diet, her environment, exercise, regularity of nursing, and many other factors which are of first importance in the regulation of the



defects.

**PREGNANCY.** On the occurrence of pregnancy during lactation, the secretion is generally diminished in quantity and of poor quality, especially in fat. In deciding the question of weaning, the health of the mother and the condition of the child are the two chief points to be considered. As a general rule it is advisable to wean the child gradually.

**MENSTRUATION** during lactation usually gives rise to slight digestive disturbances in the child. In the few cases coming under my notice, I have managed to relieve the symptoms by prescribing for the child a mixture containing Glycerine Pepsin, m. iii; Sodii Citrat., grs. ii; Glycerini, m. xx; Aq. Aneth ad.  $\text{3i}$ . Rotch<sup>15</sup> states that in this condition there is a probability of the milk being deficient in fat, with an increased proteid content.

**AGE.** The milk of women of different ages varies a little in composition. According to Kolesinsky (cited by Cautley)<sup>16</sup>, the percentage of proteid in the milk diminishes with the increase of the age.

**FOOD.** The nature of the food exercises a marked influence on the quality of the milk. Increase in the proteid diet

not only leads to an increased secretion of fat, but also to an increase in the proteid content. Deficiency of food, on the other hand, lowers both the fats and proteids.

**ALCOHOL.** Various observations have been made on the effect of alcohol on the secretion of milk, with the general result that no definite or specific effect can be attributed to it. The consensus of opinion, however, seems to be that it acts harmfully by disturbing the chemical composition of the milk, and thus brings about digestive disturbances in the infant.

**EXERCISE.** Daily walking exercise should be insisted on, as it is of the greatest value in assisting the mother to provide a suitable milk for her child. An increased proteid percentage (one of the commonest defects in breast milk) may be brought within normal limits by increased exercise to the point of moderate fatigue.

**FREQUENCY OF NURSING.** The regularity in feeding is found in practice to be a matter of the utmost importance to successful breast feeding. When the mother nurses her infant at too short intervals, the proportion of total solids in her milk is increased, rendering it difficult

of digestion, and if the intervals are unduly lengthened, the decrease in the total solids is such that an otherwise good milk becomes too watery and unfit for purposes of nutrition, however well it may be digested.

NERVOUS DISTURBANCES are capable of producing marked changes in both the quantity and the quality of the milk. The nature of the changes in milk from such causes is as yet but little understood. Rotch<sup>15</sup> is of opinion that it is the proteids which are at fault, as these are very unstable and easily affected, and that, instead of the normal proteids, others are produced which possess "toxic properties". The symptoms exhibited by an infant taking breast milk of this character are those of an acute indigestion, with evidence of impaired nutrition.

#### CLINICAL EXAMINATION of Human Milk with Results in Twenty Cases

-----

Having regard to the clinical importance of a knowledge of the constitution of the milk, I made the following analyses in cases coming under my notice in general practice. For purposes of comparison I have divided them into two different series. The first comprises those milks which, judging from the condition of the child,

were fulfilling all the requirements of a proper diet.

In the second series of cases, the children were brought to me on account of some digestive or marasmic symptoms, pointing to an inadequate supply of breast milk.

I. SERIES OF MILKS in which the mothers were healthy, and the infants were gaining in weight and digesting well

Case No.	Age of Mother	No. of Pregnancy	Age of Child	Specific Gravity	Fat	Proteid	Sugar	Salts	Total Solids	Water
1	28	4	2 Wks.	1035	2.6	1.66	7.73	0.08	12.07	87.93
2	29	1	2 Mos.	1034	1.9	2.21	6.78	0.20	11.09	88.91
3	19	2	2½ "	1032	3.0	1.83	6.75	0.21	11.79	88.21
4	35	3	3 "	1034	5.2	2.05	7.47	0.20	14.92	85.08
5	32	3	4 "	1030	4.3	1.16	6.99	0.19	12.64	87.36
6	21	1	3 "	1029	3.8	1.42	6.53	0.17	11.92	88.08
7	24	2	2½ "	1030	3.6	1.97	6.30	0.21	12.08	87.92
8	23	2	2¼ "	1031	4.1	1.49	6.92	0.22	12.73	87.27
9	28	2	2 "	1031	2.7	1.44	7.10	0.19	11.43	88.57
10	26	2	2 "	1029	3.5	1.79	6.18	0.20	11.67	88.33
Average percentage				1031.5	3.4	1.7	6.87	0.18	12.23	87.76

The specimens of milk from which these analyses were taken were all obtained from healthy mothers, and in

every case the child was thriving. The majority of these cases were brought under my notice by the mother's uncertainty as to being able to nurse the child, and her desire to resort to artificial feeding. In none of the cases was it found necessary to advise the withdrawal of the child from the breast.

The only two abnormal results are in Cases Nos. 2 and 4, where in No. 2 there is a low fat percentage of 1.9, and in No. 4 a reading of 5.2 as the fat content. As both infants were thriving exceedingly well, it did not seem necessary to wean them. The mother, in Case No. 2, was advised to take a more liberal diet, and the results were altogether satisfactory. The child was nursed at the breast alone for eight months, and was then gradually weaned to a suitable milk mixture. Note is also to be taken in this case of the high proteid value of the milk which this infant digested.

The mother in Case No. 4 was anxious regarding the quality of her milk, as her previous children whom she had nursed solely at the breast had shown symptoms of rickets towards the end of the first year. The results of the analysis as shown above justified her being advised to continue the nursing of the child, but to wean at a much earlier date than on the two previous occasions.

It is very probable that her milk towards the end of the first year became abundant in quantity but very deficient in fats and proteids, a fault of nutrition which is the most constant factor in the causation of rickets.

II. SERIES OF MILKS in which the infants were not thriving, and troubled with digestive disturbances

Case No.	Age of Mother	No. of Pregnancy	Age of Child	Specific Gravity	Fat	Proteid	Sugar	Salts	Total Solids	Water
1	31	3	8 Mos.	1032	1.1	3.14	5.94	0.17	10.35	89.65
2	32	4	4 $\frac{1}{2}$ "	1036	1.4	2.69	6.76	0.18	11.03	88.97
3	38	10	5 $\frac{1}{2}$ "	1031	1.7	2.09	6.41	0.17	10.37	89.63
4	32	4	13 "	1033	1.5	1.83	6.81	0.15	10.29	89.71
5	22	1	2 "	1025	1.8	2.66	4.37	0.19	9.02	90.98
6	25	1	2 $\frac{1}{4}$ "	1028	2.2	2.63	5.14	0.21	10.18	89.82
7	28	3	2 "	1036	2.5	3.38	6.59	0.21	12.68	87.32
8	30	2	1 $\frac{1}{2}$ "	1029	1.5	2.04	5.72	0.16	9.42	90.58
9	24	1	7 "	1031	1.1	2.89	5.82	0.15	9.96	90.04
10	27	3	4 "	1026	1.9	2.84	5.12	0.18	10.04	89.96
Average percentage				1030.7	1.6	2.62	5.86	0.17	10.33	89.66

In all these cases, advice was sought on account either of dyspeptic symptoms exhibited by the child or

through the mother's idea that it was "not getting on as well as it should". Marked digestive disturbances, as evidenced by vomiting, colic and diarrhoea, were present in all the cases, with the exception of the first four numerated as above.

CASE 1 - Child aged 8 months; solely breast fed from birth. His appetite had lately seemed to be unsatisfied; he had been very fretful, with frequent fits of crying. As the child had arrived at an age when it could be safely weaned, and as the results of the analysis showed that the mother's milk was so very deficient in food value, complete cessation of nursing and the substitution of a milk mixture were advised, with the result that in a few days all the unsatisfactory symptoms had disappeared.

CASE 2 - Child aged  $4\frac{1}{4}$  months, suffering from mild attack of varicella - breast and bottle fed (mixture of milk and water, half and half). The child had evidently not been thriving on this diet. He had lost his natural plumpness, and the muscles were very flaccid and soft. The child was very drowsy, but the mother stated that at times he was very sleepless and irritable. He was also troubled with constipation. The mother's milk was very deficient

in quantity, and the analyses showed it to be defective in quality. The surroundings of the home were such, however, that any improvement in the milk by suitable diet or otherwise was impossible, and the child was put on a mixture containing milk, .2 tablespoonfuls; cream, 1 teaspoonful, gradually increasing to 2; water, 2 tablespoonfuls; lime water, 3 teaspoonfuls; and sweetened with small piece of sugar, and this was given regularly every  $2\frac{1}{2}$  hours.

The child got on very well on this mixture, and, although progress was very slow, the improvement was maintained, and at the end of two weeks, the nutritive value of the mixture was increased by the addition of 1 teaspoonful of cream and 1 tablespoonful of milk to each feed.

CASE 3 - Child aged  $5\frac{1}{4}$  months. Mother anaemic, and worried by family matters. The child presented a flabby and pasty appearance. The mother stated that he was restless and irritable, and always very hungry. He had got a "pick of what was going" - a very common method of supplementary feeding adopted amongst the working classes. The bowels were constipated, with occasional attacks of diarrhoea, and the motions were pale and curdy. It was



evident that this was a case in which the child was not able to assimilate the form of extra food it was receiving, the great bulk of it passing through undigested.

The treatment adopted in this case was the clearing and cleansing of the bowels by the administration of a powder containing calomel, grs.  $\frac{1}{4}$ ; salol, grs.  $\frac{1}{2}$ ; one night and morning for three days. The mother was warned against the pernicious practice of giving the child anything but what was ordered. She was advised to give the breast ultimately, with a milk mixture containing 3 table-spoonfuls each of boiled milk and water, 3 teaspoonfuls of cream, 1 tablespoonful of lime water, and sweetened with small lump of sugar; interval between feeds, 3 hours. The child throve very well on this diet, and the quantity of the milk was gradually increased. It was found advisable, on account of the increasing trouble with family worry, to discontinue the breast feeding at the seventh month. I found that the mother, unfortunately, resorted to the "stuffing" process again about the tenth month, with the result that, when the child was a year old, it was seized with convulsions, and died two days later.

CASE 4 - Child aged 13 months. Mother had an abundant supply of milk, examination of which showed a marked deficiency

of fat and proteids. This sample is typical of "prolonged lactation" milks. The child was receiving a sufficiency of diet by means of bread and milk, porridge, and milk puddings. He was affected with a slight urticarial eruption, and suffered from constipation. The mother made complaint of severe headaches and neuralgia.

Occasional small doses of calcined magnesia were ordered for the child, and the withdrawal of the child from the breast advised. Explanations were given to the mother as to the deteriorated quality of her milk, and the unnecessary drain which was being made on her own system.

CASES 5 TO 10 - These cases all presented very much the same clinical picture. The mothers were all in good health, but the children were not thriving on the maternal milk, and were subject to vomiting (a very common symptom), colic, and diarrhoea; all symptoms pointing to a gastrointestinal disturbance, and due undoubtedly to the unsuitability of the breast milk.

In all of these cases we have a low fat percentage, associated with a high proteid content. Unsatisfactory attempts were made to improve the quality, and ultimately the infants had to be completely weaned.

The knowledge derived from a qualitative examination of the composition of the maternal milk is of great value to the practitioner in cases where the infant is not thriving, and also in those cases where the mother is anxious concerning the suitability of her milk for the child. If the practitioner is thoroughly satisfied that the breast milk is sufficient in quality and quantity for the needs of the child, he can more confidently advocate the continuance of the maternal nursing, and discourage any attempt made to wean that child.

The condition of the child must also be taken into account, as the results of the examination do not always agree with the clinical observations. For example, in Case No. 4 of Series No. I, an excessive amount of fat in the milk was well borne by the child, which would certainly have excited dyspepsia in another. Indeed, I am of opinion that the condition of the child is the main standard whereby to judge the suitability of the milk, and that an analysis is useful in many cases only as a confirmatory observation.

## METHODS OF EXAMINATION

-----

The methods employed in the examination of the foregoing samples of milk were as follows. The calculation methods used for the determination of the proteids and the sugar were chosen for their greater simplicity, compared with the rather tedious method of Kjeldal, which is much too elaborate a process for a general practitioner to undertake. The samples, drawn from the middle milk, were obtained by means of a breast pump in the forenoon, and examined the same afternoon in the Public Health Laboratory of St. Mungo's College.

**SPECIFIC GRAVITY** - This was obtained by the use of the lactometer. In a few cases in which the sample was small in amount, the specific gravity bottle was employed.

**TOTAL SOLIDS** - By means of a pipette, 5 cc. of the milk were run into a previously weighed platinum dish, and then rapidly weighed to prevent any evaporation taking place. The dish was then heated over a water bath, and evaporated to dryness, afterwards being placed in an incubator (212° F.) to ensure complete absence of moisture, and

finally being thoroughly dried and cooled in a dessicator. The dish and residue were then weighed, and by subtracting the weight of the dish, the weight of ash in the 5 cc. of milk was ascertained, and calculated out as a percentage.

ASH - The residue, or dried solids, in the last determination, was incinerated, cooled, re-weighed, and calculated out in a similar manner.

FAT - Among the processes for the rapid determination of fat, those employing centrifugal action have been found most convenient. The following method devised by Leffman and Beam<sup>17</sup> in 1889 has proved satisfactory on the score of accuracy, simplicity, and ease of manipulation, and was employed by the writer in his series of analyses.

The distinctive feature is the use of fusel oil, the effect of which is to produce a greater difference in surface tension between the fat and the liquid, in which it is suspended, and thus promote its readier separation. This effect has been found to be heightened by the presence of a small amount of H.Cl.

The test bottles had a capacity of about 30 cc., and were provided with a graduated neck, each division of which represented 0.1 per cent. by weight of butter fat.

15 cc. of the milk were pipetted into the bottle; 3 cc. of a mixture of equal parts of amyl alcohol and strong hydrochloric acid added, mixed, the bottle filled nearly to the neck with concentrated sulphuric acid. The liquids were all mixed by holding the bottle by the neck and giving it a gyratory motion. The neck was filled to about the zero point with a hot mixture of sulphuric acid and water. The bottle was then placed in the centrifugal machine, and after rotation for from one to two minutes, the fat collected in the neck of the bottle, and was read off as a percentage.

Experience by analysts in various parts of the world has shown that the results thus obtained are reliable. As a rule they do not differ more than 0.1 per cent. from those obtained by the Adams' process, and are generally even closer.

**PROTEIDS** - The formula devised by Richmond was employed in the calculation of the proteids. The specific gravity, fat, total solids, and ash being known, the percentage of proteids may be approximately calculated, and the results are sufficiently accurate for the purposes of the general practitioner.

Richmond's formula -  $P - 2.8 T + 2.5 A - 3.33 F -$

$0.7 \frac{G}{D}$ , in which P is the proteids, T the total solids, A the ash, F the fat, D the specific gravity (water at  $15.5^{\circ}$  being taken as), and  $G = 1000 D - 1000$ .

SUGAR - The difference between the total solids and the fat, proteids, and ash gives the lactose. In this formula, it has been assumed that everything that is not fat, proteids, or ash is milk sugar, an assumption which is not strictly correct, and which introduces a slight error.

#### SUBSTITUTE FEEDING

-----

Taking human milk as the natural and most perfect food for a young child, our object must be to approximate to this standard in the substitute we propose to adopt. The milk of some animals, notably that of the ass, resembles woman's milk very closely, but cows' milk, which is plentiful and cheap, is usually chosen, and when properly prepared, is perfectly efficient for the purpose required. This milk, as the basis of the substitute food, therefore, requires some consideration. The chemical constitution of cows' milk is widely different from that of human milk, and it is necessary that these differences

be sufficiently appreciated. All authorities are practically agreed in recommending the use of the mixed milk from a herd, and the following composition of cows' milk is given by Richmond<sup>18</sup> on the basis of two hundred thousand analyses:-

	<u>Human Milk</u> According to Carter and Richmond <sup>11</sup>	<u>Cows' Milk</u>
Re-action	Alkaline	(Amphoteric when fresh (Acid on standing)
Fat	3.1	3.9
Proteids	1.8	3.4
Sugar	6.7	4.75
Salts	0.24	0.75
Water	88.12	87.10

Cows' milk thus contains more than twice the amount of proteids present in human milk. Moreover, they show marked differences in character. Koenig<sup>19</sup> divides the proteids as follows:-

<u>Women's Milk</u> -	
Lactalbumin 1.26%	Caseinogen 1.03%
<u>Cows' Milk</u> -	
Lactalbumin 0.53%	Caseinogen 3.02%



It is this excess of caseinogen in cows' milk which constitutes one of the greatest difficulties in its modification for infant feeding. The caseinogen is readily coagulated by the rennin ferment, and large tough curds are formed, which are only slowly dissolved by the action of the digestive fluids. The lactalbumin is not coagulated by rennin, and owing to the small percentage of caseinogen present in human milk, the curd is small and flocculent.

Unfortunately, cows' milk is singularly open to contamination from many different sources, for whereas human milk passes direct from the secreting gland to the child's mouth, cows' milk, in making the journey between these two points, is seriously exposed at every stage of its passage. Admixture also of chemical preservatives, though not so common as formerly, is yet far too frequent. Even the milk of healthy mothers, obtained under aseptic precautions, has been found to contain micro-organisms. They come from the skin near the orifice in the nipple. In the case of the cow, the liability to such infection is much greater.

As evidence of the gross contamination which may be contained in cows' milk as delivered to the consumer, I quote the following statement prepared by Dr. R. M.

Buchanan<sup>20</sup>, Glasgow Corporation Bacteriologist. The milk examined was that supplied to the Infants' Depot, and which is always passed through an electrically driven separator. The sediment of 150 gallons was examined on several successive days. Dr. Buchanan's description is as follows:-

"The five deposits submitted consist of repulsive  
 "pultaceous masses, composed of greyish dung-like  
 "material, interspersed with hairs, and covered  
 "with dirty greyish slime. Two of the samples  
 "were selected for detailed microscopical and  
 "bacteriological examination, and presented the  
 "following appearance:-

"MICROSCOPICAL EXAMINATION - (a) Greyish dung-like  
 "material showed many dust-like particles of an  
 "indefinite nature, black, yellow and brown;  
 "fragments of vegetable fibres - a few colour-  
 "less, but majority yellowish brown, and some  
 "apparently partly digested; some semi-crystal-  
 "line translucent masses varying in size;  
 "squamous epithelial cells in large number;  
 "leucocytes, a few; fat globules, a few; and  
 "hairs, a few.

"(b) Dirty-greyish slime consisted mainly  
 "of leucocytes, numerous fat globules, and fat-  
 "ty particles. Squamous epithelial cells were  
 "abundant, but scarcely any dust particles or  
 "vegetable fibres were detected. Bacteria were  
 "numerous as compared with the number in the  
 "greyish material, and comprised cocci, short  
 "bacilli, and a few streptococci."

BACTERIOLOGICAL EXAMINATION  
-----

	Deposit of 29th May, 1906 -----	Deposit of 31st May, 1906 -----
"Bacterial Content	Estimated at 145,080,000 per gramme	Estimated at 142,200,000 per gramme
"Bacillus Enteritidis) Sporogenes ) ) "Bacillus Coli )	Absent in 1 mg.	Absent in 1 mg.
"Coliform Bacilli (Bacillus Lactis Aerogens type)	Estimated at 2,520,000 per gramme	Estimated at 420,000 per gramme

This sediment, on being weighed, was found to average 4.76 oz. when moist, whilst on drying at 100° C., it was reduced to 3.01 oz. This represents over the total volume of milk an average of 8.8 grains of dried material per gallon, or rather more than 1½ grains per pint.

Eastes<sup>21</sup> examined 186 samples of milk obtained from all parts of the kingdom. The tubercle bacillus was present in 11 cases. Pus or muco-pus was found in 134 cases. Blood was present in 24 specimens, and streptococci were present in 106 cases. Altogether, 80 per cent. of the milks were unfit for human consumption.

These investigations demonstrate very clearly the great contamination which milk undergoes, and show the necessity there is of further legislation, or more efficient administration of the existing laws, to ensure the supply of a perfectly pure milk, as it is only with such a milk that we can expect to get the most satisfactory results in substitute feeding.

#### METHODS OF SUBSTITUTE FEEDING

-----

All are agreed that the best results are obtained for both mother and child when the infant is fed at the breast, and it is therefore the duty of medical practitioners to encourage their patients in the fulfilment of their maternal obligations. It is only where careful observation shows that maternal nursing is inadequate that substitute feeding should be resorted to. If carefully and properly managed, the substitute method, however, gives very satisfactory results. The care and conscientiousness of the mother, however, must be much greater than in the case of natural nourishment. Not only has the composition of the food to be considered,

but also the precautions in the handling of the milk, and the cleanliness of the utensils employed.

A survey of the various methods and principles advocated by different exponents of the problem of substitute feeding shows a very wide diversity of opinion. Some authorities, most of them French (Budin<sup>22</sup>, Rothschild<sup>23</sup>, Bonifas<sup>24</sup>), contend that cows' milk undiluted, provided it has been sterilized, can safely be administered even to the youngest child. This view has not found general favour in this country. It is contrary to the great mass of clinical evidence, which has taught us that the majority of healthy infants cannot properly digest pure cows' milk until near the end of the first year. There are undoubtedly many exceptions to this rule, and in some cases it may be expedient to resort to a diet of whole milk long before the child, from the theoretical standpoint, could be expected to digest it. ~~Sigert~~<sup>25</sup> recommends for infant feeding the use of whole milk curdled by rennet, with the addition of water, cream, albumin, etc., as desired; and Baginsky<sup>26</sup> speaks favorably of buttermilk, made from pure cream, which is soured by means of bacteria, producing a lactic acid fermentation, wheat flour and cane sugar being added in certain proportions. He has found this food of value principally in the acute

and chronic gastro-intestinal disorders of infants.

Whey dilution is strongly advocated by Dr. Ashby of Manchester<sup>27</sup>, since it makes a substitute in which the more difficultly-digested casein can be advantageously replaced by the easily digested whey or albumin proteid. Whey may be mixed with milk, top milk, or cream in any desired percentage. This method is particularly useful in cases of gastro-intestinal disturbance, due to intolerance of the casein content. The objection to its use as a routine method in practice is the care and trouble necessary in the preparation.

The simple dilution of cows' milk with water or barley water is, however, the method favoured by most authorities, but they differ materially in the degree and nature of the dilution. Morfan<sup>28</sup>, Weissbein<sup>29</sup>, and others advise a mixture containing two parts of milk and one of water, with sugar added. As a great number of the digestive ailments of infants are undoubtedly due to the ingestion of excessive quantities of casein, it is evident that this mixture, with its high proteid content, will not be well borne in the earlier months of life, and at a later period the low fat content will be an objection.

A rational infants' food should be adaptable to the weakest child, and should allow the widest modification

in the proportions of fat, albumin and carbohydrates. These requirements are all met by the method of dilution advocated by Biedert<sup>30</sup>, Reinach<sup>31</sup>, Jacobi<sup>32</sup>, etc. To supply the deficit of fat, Biedert formulates his famous cream mixture, made by diluting one part of a cream, containing from 8 to 10 per cent. of fat, with three parts of water, and adding sugar. Undoubtedly, the administration of high dilutions of milk with cream and sugar added, is one of the most widely applicable, and will be found to be the most serviceable method in the hands of the general practitioner.

The following tables of dilution, advised by Cautley<sup>33</sup>, are those which I have employed during the past five years, and I have never been disappointed in the results obtained by their use. The strengths represented in the tables are based on the average percentage of fat, sugar and proteids, which the average child can digest at a given age. The mixture can be easily modified according to the clinical evidence afforded by the child's digestion and nutrition.

	<u>1st week</u>	<u>2nd week</u>	<u>3rd week</u>	<u>4th week</u>
Milk	2 Teaspoon.	3 Teaspoon.	4 Teaspoon.	5 Teaspoon.
Cream	1 "	1 "	1 "	1 "
Water	5 "	6 "	7 "	8 "
Lime Water	1 "	1 "	1 "	1 "
Sugar	1 lump	1 lump	1 lump	1 lump
Directions - One feed every 2 hours				

	<u>2 months</u>	<u>3rd-6th month</u>	<u>6th-9th month</u>
Boiled Cows' Milk	2 Tab.spoon.	3-4 Tab.spoon.	5-6 Tab.spoon.
Boiled Water	2 do	--	--
Barley Water	--	3-4 do	5-6 do
Cream	1 Teaspoon.	1-2 Teaspoon.	3-4 Teaspoon.
Lime Water	3 do	1 Tablespoon.	1 Tablespoon.
Directions: One feed every 2½ hrs.		One feed every 3 hrs.	

Cautley is of opinion that cane sugar can readily replace lactose without any ill effect, and I think that this holds good as a general rule. In a few of my cases I found it advisable to substitute a known quantity of sugar of milk. In finding the proper proportions necessary for a particular child, the one great difficulty is in the varying strengths of different milks and creams; but until the community is supplied with milk and cream of certified strength, this objection will apply to every method of home modification.

THE ADDITION OF LIME WATER to cows' milk is generally considered to be the best means of reducing the acidity of the



latter. Bi-carbonate of soda (1 or 2 grains to the oz.) may be used. It is a more powerful antacid, but I have found it to agree better than lime water with some infants. Both those alkalies have some effect in causing the casein to coagulate, on addition of acid, in smaller masses, but their value in this respect is not great.

Some recent observations by Dr. Poynton<sup>34</sup> seem to show that the addition of 1 grain of citrate of soda to the ounce of milk is more effectual in its action on the curd, and he has had great success with this method. I have employed it in a few cases of dyspepsia, and have found it very useful.

**THE ADDITION OF BARLEY WATER** - The use of a cereal decoction as an diluent of the milk for young infants is a subject much discussed among those interested in infant feeding, and is favored by many authorities in the belief that this facilitates the digestion of casein, besides adding slightly to the nutritive value of the milk mixture. The amylolytic function, according to most observers, is slow in becoming established. Although present at birth, it has no decided power before the period of dentition (Monti<sup>35</sup>). If given in sufficiently weak solution, however, barley water may be added in the third month. The strength which I usually employ is  $1\frac{1}{2}$  teaspoonfuls of

patent barley, mixed to smooth paste with water, and a half pint of barley water added, allow to simmer for 5 or 6 minutes, stirring all the time.

THE HEATING OF MILK - Most authorities are agreed as to the advisability of the use of heat in preparing cows' milk for infants, differing only in their choice of the degree to be employed.

The Committee on Physical Deterioration, after weighing the medical evidence on the subject reported<sup>36</sup>, that "professional opinion, being so acutely divided on this important question, the subject should be specially investigated by a small body of experts". They have no doubt, however, that the first step to be taken with milk on its leaving the cow, is prompt refrigeration to 40° F.

Jacobi<sup>37</sup> says with truth that so long as milk is exposed to contagion from scarlet fever, diphtheria, typhoid fever, etc., as ordinarily obtained, it needs to be boiled.

Vincent<sup>38</sup> rightly insists that the prevention of contamination is the prime necessity, and that no amount of pasteurization or sterilization can convert an unclean milk into a clean one.

Until some system, however, is devised which will

ensure the supply of pure clean milk, we shall require to employ some degree of heat to counteract the dangers present under existing conditions.

In the preparation of the milk mixture at home, I advise the use of an Aymard's sterilizer. The price is low, and the manner of using it is very simple. Some water having been made to boil in the saucepan, the jacketed milk container is placed in position, and the whole is set over the fire for about 5 minutes, which is sufficient to bring the milk to a temperature exceeding 200° F., without giving it the disagreeable flavour due to overheating or "burning", which is so common with ordinary boiled milk.

The choice of a suitable food is not the sole factor to be taken into account in the consideration of substitute feeding. It is very important that mothers and nurses should be educated as to the necessity of absolute cleanliness of jugs, bowls, feeding bottles and teats, and impressed with the advantages of regulated quantities of food at uniform intervals. I am convinced that much of the non-success in infant feeding, both breast and substitute, is due to overfeeding at irregular intervals.

A pure milk supply is so essential a preliminary to

success in any movement towards the reduction of the infantile death-rate that many London and Provincial municipalities have taken the matter in hand, and have organized a system of milk depots, copying as far as possible the admirable organizations at work in France. The work done there has been attended with gratifying results, and may be classified as follows:-

- (1) "Consultations de nourissons"
- (2) Creches and dispensaries
- (3) "Gouttes de lait"

There are two systems of consultations of nourissons - the one is of the nature of a lying-in institution, in which the children born there are kept as out-patients under medical supervision for the first two years. Breast feeding is encouraged by every possible means, but where impracticable, sterilized milk is supplied in bottles.

In the second type of consultation, there is no hospital connection, but the method is otherwise similar. The task is here more difficult, for while some of the infants are healthy, others are suffering from more or less serious digestive disturbances.

These consultations were founded by Professor Budin

in 1892, and now exist in a large number of communes in France. Statistics which have been recently published<sup>39</sup> leave no doubt regarding their success:-

	Foundation of Consultation in	Infantile Mortality (per 1000 births)	
Arques	1903	1898-1903 <u>191</u>	1903-1905 <u>106</u>
St. Pol sur mer	1903	1898-1902 <u>288</u>	(1903 <u>209</u> (1904 <u>151</u> )
Varengeville-sur-mer	1904	1898-1904 <u>145</u>	1904 <u>77</u>
Auxerre	1904	1898 <u>205</u>	(1904 <u>120</u> (1905 <u>60</u> )
Villeneuve sur Vorne	1904	1898 <u>163</u>	(1904 <u>82</u> (1905 <u>37</u> )

The good results obtained by these undertakings are mainly due to the increase in breast feeding, which was tending to disappear everywhere. At Varengeville before the institution was founded, not a single woman fed her infant at the breast; since its foundation, the proportion rose to 47.5 per 100 in 1904, and to 75 per 100 in 1905. A survey of the statistics relating to the Paris consultations show that the results obtained by those in connection with the hospital are very much superior to the others. This must be attributed to the fact that

the infants are from the first brought up under medical supervision. Mothers are strongly urged to suckle their infants, with the result that about 95 per cent. are induced to do so. At the other institutions, mothers have often weaned their infants before they apply for assistance.

**CRECHES** - In these institutions, usually founded by private initiative, and in some cases receiving municipal assistance, infants are received at ages varying from one to six or nine months, and are taken care of during the day. The mother is encouraged to attend at stated hours to give the infant the breast; when this is not possible, it is fed upon milk by the persons in charge of the creche. These institutions also supply milk for children who are not left there.

**THE "GOUTTE DE LAIT"** is a milk dispensary from which infants are fed under medical supervision upon sterilized milk with or without modification. About one hundred towns in France are now provided with one or more of these depots, which are conducted on a philanthropic basis, and supported by voluntary subscriptions. The "goutte de lait" may be regarded as the prototype of the Infants'

Milk Depots in this country, but the French plan has not been uniformly carried out - at any rate, in Glasgow - particularly in respect of the medical supervision of the children, and the discriminating distribution of the milk. Further, in this country the depots are carried on by the municipalities, and are larger and more expensive as to plant than the ordinary French models.

I recently made a visit of inspection to the Glasgow Municipal Milk Depot, and the following is a brief description of the method of modification carried on there.

The milk, on arrival at the Depot, is passed through an electrically driven separator. The separated milk is then modified in portions according to the three following degrees of dilution:-

- 1 - Equal quantities of milk and water for infants up to 2 months old
- 2 - Two parts of milk to one part of water for infants up to 5 months old
- 3 - Three parts of milk to one part of water for infants over 5 months old

$1\frac{1}{2}$  oz. of sugar,  $\frac{1}{6}$  oz. of salt, and a sufficient quantity of cream to bring the fat percentage up to 3.5, are added to each gallon of the mixture. It is now poured by means of a mechanical bottle filler into bottles, which have

been previously washed by revolving brushes, then rinsed and dried on a drainer. The quantity of milk in each bottle varies, as shewn below, according to the age of the child. The bottles are then capped, and wheeled on trays into the steriliser. As soon as the thermometer, which is placed on the top of the steriliser, indicates  $102^{\circ}$  C., the time is noted, and that temperature is maintained for three-quarters of an hour. The bottles are then taken out and allowed to cool before being placed in the baskets, containing nine bottles, which are intended to feed one child for twenty-four hours. The following table shows the strength and quantities for each age:-

Age	Single Quantity	Dilution	No. of Bottles	Quantity of Pure Milk per day	Cost per day
1 to 2 wks.	$1\frac{1}{2}$ ozs.	1 to 1	9	$6\frac{3}{4}$ ozs.)	2d
2 to 8 "	3 "	1 to 1	9	$13\frac{1}{2}$ " )	
2 to 3 mons.	$3\frac{1}{2}$ "	2 to 1	9	$20\frac{3}{4}$ " )	
3 to 5 "	$4\frac{1}{2}$ "	2 to 1	9	30 "	$2\frac{1}{2}$ d
5 to 7 "	$5\frac{1}{2}$ "	3 to 1	9	36 " )	3d
Over 7 "	6 "	3 to 1	8	36 " )	

The baskets are sold at the Depot, but the greater number are sent to dairies for distribution in different parts of the city. Instructions are given that before



the child is fed, the stoppered bottle has to be placed in a basin of hot water for a few minutes. The stopper should be then removed, and the teat fitted to the bottle, thus avoiding any contamination of the milk. The average number of baskets issued daily is about 600.

The main objection which I would urge against Municipal Milk Depots is, that they relieve the mother of the responsibility of preparing the infant's food, and the medical practitioner of his proper function of ordering a diet suitable in quality and quantity for the particular child. The depots are, no doubt, valuable to a certain class of the community, but where ordinary care and cleanliness in the home can be relied on, it is much better to have the milk modified at home. For this class let the Municipality cater by providing a supply of pure unmodified milk.

**LABORATORY MILK** - The introduction of the Milk Laboratory is the work of T. M. Rotch<sup>40</sup> of Boston, and represents one of the latest advances in the scientific feeding of infants. The great advantage of Laboratory Milk is that we can be sure of the exact composition of the milk food we are giving. In the Laboratory method, every precaution against contamination of the milk is taken, and consists

of selection and care of the cows, sanitary precautions in the building and arrangements of the farm buildings, and strict supervision to ensure cleanliness in the handling of the milk. By means of a separated cream of known percentage, diluted with separated milk and a solution of milk sugar, any desired milk mixture can be prescribed so as to contain the various constituents in any proportion required. It is certain, however, that milk laboratories will for the present, at least, be out of the reach of the majority of practitioners, and the expense will stand in the way in many cases. Intelligent home modification of milk still remains our chief resource for the substitute feeding of the great majority of infants.

#### PROPRIETARY FOODS

-----

One more method of infant feeding requires mention, i.e., the popular one by means of "proprietary foods". Unfortunately, they are most extensively used, and appear to be recommended by some members of the profession. Some of these foods - Nestle's, Horlick's Malted Milk, Allen and Hanbury's Nos. 1 and 2 - are advertised as

substitutes for breast feeding, and recommended for use alone. Others, such as Mellins', Benger's, Ridge's, Savory and Moore's, Allenbury No. 3, and Frame Food, are intended to be prepared with milk. A third class are those foods prepared from Cows' Milk, namely, Condensed Milk, with or without added sugar, and Peptonised Milk. All these foods are open to serious objections. They are unnecessary, expensive, and unreliable regarding composition and freshness. They all fail to satisfy the primal requirements of an infant's diet.

However greatly various authorities may differ as to the most expedient method of providing a substitute diet, all of them are united in their condemnation of these dried and condensed preparations as a permanent dietary for young infants. They are useful, however, as adjuvants, and may be used as an addition in small quantity to the milk mixture after the sixth month. I have employed advantageously a very dilute solution of malted milk (1 to 2 teaspoonfuls to tumblerful of water) in a few cases of dyspeptic vomiting.

## CONCLUSIONS

-----

Reviewing the study of the question in the light of my practical experience as a general practitioner - especially amongst the working class of the community - I am enabled to make the following deductions, and to formulate proposals, the practicability and success of which in some form or other have been abundantly proved at home and abroad.

In the causation of the high infantile mortality rate, we have several deplorable social conditions to contend with:-

1. The increased non-domestic employment of mothers
2. The increased urbanisation of the population
3. The bad housing and overcrowding of the poor

All these are factors which tend to the underfeeding and overworking of the mothers, and thereby materially diminish the chances of successful breast feeding, which leads to the necessity of hand rearing, and which, owing to the lamentable ignorance displayed by mothers, results usually in the careless administration to their

infants of an improper and unwholesome diet.

The remedies, so far as they concern the medical point of view, which I would urge as a means of combating this sacrifice of infant life, are:-

1. The encouragement of breast feeding:-
  - (a) By the education of mothers and prospective mothers in the care and management of infants
  - (b) By facilities being given by municipalities for the analysis of doubtful breast milks, and for appropriate advice and treatment
  - (c) By supplementing the diet of poor mothers, where found necessary, either by the Poor Law Authorities, or by philanthropic agencies
  - (d) By instituting a system of trained nurses who would visit the homes, and give advice, where no medical man was in attendance
2. A greater interest to be taken by medical practitioners in the proper methods of infant feeding, to enable them to prescribe suitable home modifications of milk when breast feeding fails
3. The establishment of milk depots for the supply of:-
  - (a) Pure milk, for purposes of home modification
  - (b) Modified milk, as at present sold in existing municipal depots, but under more strict supervision, and for use only when breast feeding has proved unsatisfactory. In France and Belgium

the importance of medical supervision in this respect is more fully recognised than in this country. In the supply of sterilised and modified milk from depots, an attempt should be made to combine the provision of milk with a weekly medical examination of the child, and an adaptation of its food to the special requirements of each case. I am not in favour of the hazardous use of milk depots by all and sundry, and attention should be given to the possibility of a supply of depot milk, encouraging mothers in the non-suckling of their infants.

4. The general establishment of Creches where the children of working mothers may be fed and cared for during working hours
5. The discouragement of the use of proprietary foods as a sole or permanent method of feeding

The subject is well deserving of continuous study and careful experiment, and the co-ordination of measures already in operation, or about to be adopted, might with advantage be borne in mind in any efforts in extended work.

-----

## R E F E R E N C E S

-----

1. Report of Inter Depart. Comm. on Physical Deterioration, 1904, Vol. I, p. 44
2. Chalmers, "Infantile Mortality", Journ. Pub. Health, May 1906, p. 423
3. Newman, "Infantile Mortality", London, 1906, p. 221
4. Hope, Liverpool Medical Journal, No. 12, 1887, p. 158
5. Howarth, "The Influence of Feeding on the Mortality of Infants", "Lancet" 1905, Vol. II, p. 210
6. Brindley, Ann. Rep. of Med. Off. of Health of County Borough of Bury, 1905
7. Chalmers, Ann. Rep. of Med. Off. of Health of Glasgow, 1905
8. Monti, "Kinderheilkunden in Einzeldarstell", Wien, 1899, Vol. I, p. 69
9. Holt, "Diseases of Infancy and Childhood", 2nd edit., 1903, p. 130
10. Rotch, Text Book of Pediatrics, 3rd edit., 1901, p. 127
11. Carter and Richmond, Brit. Med. Journ., 1898, Vol. I, p. 199
12. Ashby and Wright, "The Diseases of Children", 4th edit., 1899, p. 46
13. Vincent, "The Nutrition of the Infant", 1904, p. 18
14. Koeppe, "Jahrbuch für Kinderheilkunde", Bd. XLVII, p. 389
15. Rotch, Text Book of Pediatrics, 3rd edit., 1901, p. 139
16. Cautley, "The Feeding of Infants", p. 83

17. Leffman and Beam, "Food Analysis", London 1901, p. 205
18. Richmond, H. Droop, "Dairy Chemistry", London 1899, p. 120
19. Koenig, Brit. Med. Jour., 1902, Vol. II, p. 657
20. Buchanan, cited in Report of National Confer. on Infantile Mortality, London 1906, p. 288
21. Eastes, Brit. Med. Jour., 1899, Vol. II, p. 1341
22. Budin, "Manuel pratique d'allaitement", Paris 1905
23. Rothschild, Brit. Med. Jour., 1902, Vol. II, p. 670
24. Bonifas, "Progres Medical", Feb. 24, 1900, p. 113
25. Siegert, Münch Med. Woch, July 16, 1901, p. 1164
26. Baginsky, Brit. Med. Jour., 1902, Vol. II, p. 692
27. Ashby and Wright, "The Diseases of Children", 4th edit., 1899, p. 50
28. Marfan, "Traite de l'allaitement et de l'alimentation des enfants du premier âge", 2nd edit., Paris 1903
29. Weissbein, Deutsche Medicin, Woch, July 24, 1902, p. 541
30. Biedert, "Kinderernährung un Säuglingsalter", 4th edit., 1900
31. Reinach, Münch Med. Woch, 18 Juli, 1899, s. 956
32. Jacobi, "Therapeutics of Infancy and Childhood", Philadelphia, 2nd edit., 1896, pp. 20 and 510
33. Cautley, "The Feeding of Infants", London 1897, p. 173
34. Poynton, Brit. Med. Jour., 1905, Vol. II, p. 1021
35. Monti, "Kinderheilkunden in Eunzeldar", 1899, Vol. I, p. 100
36. Report of Inter-Depart. Comm. on Physical Deterioration, 1904, Vol. I, p. 55
37. Jacobi, "Therapeutics of Infancy and Childhood", 2nd edit., 1896, p. 494



38. Vincent, "The Nutrition of the Infant", London, 2nd edit.,  
1904, p. 18
39. Brit. Med. Jour., 1906, Vol. II, p. 51
40. Rotch, Brit. Med. Jour., 1902, Vol. II, p. 653